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Malpositioned posterior chamber lenses: Etiology, prevention, and management

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ABSTRACT

The various types of posterior chamber intraocular lens malpositions, in increasing degrees of severity, are described. These include pupillary capture, optic decentration, malpositioned loop, windshield wiper, sunrise, sunset and lost lens syndromes. The etiologies, management, and prevention of these complications are discussed.

Key Words: cystoid macular edema, decentration, dislocation, lost lens syndrome, malpositioned loop, posterior chamber intraocular lens, pupillary capture, sunrise syndrome, sunset syndrome, windshield wiper syndrome

Intraocular lens (IOL) malposition manifested as dislocation, subluxation, or decentration is a complication associated to varying degrees with every IOL style. Subluxation is especially common with iris supported lenses. There is a smaller incidence with anterior and posterior IOLs. In the adjunct study of the FDA report by Worthen et al.,[1] 1.8% of iris fixated and 1.6% of iridocapsular fixated IOLs subluxated. Other authors have reported subluxation rates as high as 5.0%.[2] Keates[3] reported the anterior chamber IOL subluxation rate to be 0.7%, while a 0.4% incidence occurred in the adjunct study.[1]

A remarkably low incidence of posterior chamber lens malposition has been confirmed by reports of 0.40% in the FDA study,[1] 0.40% by Kratz,[4] and 0.24% by Kline (O.R. Kline, Jr., M.D., U.S. Intraocular Lens Symposium, Los Angeles, April 1984). As more surgeons make the transition to extracapsular cataract extraction and posterior chamber lens implantation, complications related to this transition and the larger number of posterior chamber lenses implanted can be expected.

We review the various types of posterior chamber lens malpositions in an order of increasing degree of severity to discuss their etiology, prevention, and management.

PUPILLARY CAPTURE

Pupillary capture occurs when a portion of the optic of a posterior chamber lens is anterior to the iris plane (Figure 1). There is usually contact between the iris and the edge and posterior surface of the lens optic.[5-11]

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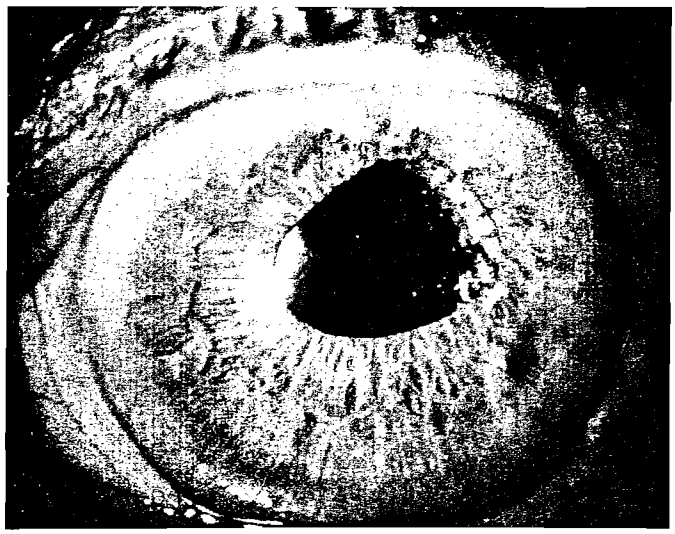

Fig. 1. (Smith) In pupillary capture, the optic of the posterior chamber lens is anterior to the iris plane.

The syndrome has also been named pupillary entrapment and iris retraction syndrome. Reports of the incidence of this problem are shown in Table 1.

Table 1. Reported incidence of pupillary capture.

Author	Incidence	Number of Eyes
Kratz[4]	1.40%	1,000
Thrasher*	1.10%	1,333
Kline[12]	0.95%	524
Faulkner[13]	2.60%	300
Stark[14]	0.96%	311
Southwick and Olson[15]	0.60%	256

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Pupil dilation in the early postoperative period may encourage formation of pupillary capture. Pallin[16] noted a 1.3% incidence in 150 cases of uniplanar posterior chamber IOLs that were sulcus fixated, while there was no occurrence in 61 cases using similar lenses that were bag fixated. Gills[17] suggested that very flexible loops could also cause this complication on contraction of the capsular bag.

Lindstrom and Herman[7] reported a 3% incidence of this complication with uniplanar lenses (100 cases) and a 1% incidence with 10-degree angulated loops (200 cases). Apple et al.[18] supported these observations and Kratz[4] recommended the concept of 10-degree haptic angulation to reduce the incidence of pupillary capture. We have also seen this complication when an angulated or vaulted posterior chamber lens is placed in the eye in a reversed fashion so the optic is vaulted toward the iris instead of away from it.

Rock and Rylander[10] felt that iris retraction was a more appropriate term for this complication when it occurred in the late postoperative period. They found a high predilection for this syndrome in the glaucomatous eye, since it occurred in 28.3% of eyes they studied with chronic open angle glaucoma that had posterior chamber lens implantation (53 eyes). They postulated a relationship between preoperative miotic use and increased iritis.

Patients with pupillary capture are usually asymptomatic; however, there are generally precipitates on the IOL, and frequently a low-grade iritis is present. Cystoid macular edema (CME) may be related to this inflammatory state.[11] If an iridectomy has not been performed in an eye with a uniplanar posterior chamber IOL, total pupillary capture can result in the symptoms and signs of pupillary bock.[9]

Managing this problem in the early postoperative period consists of pupillary dilation to break the synechias and permit the optic to assume its proper position, followed by miotics. If this is unsuccessful, the optic may be repositioned using external pressure from two cotton-tipped applicators soaked in topical anesthetic.[7] Pressure is placed over the loops located in the ciliary sulcus to compress the IOL (Figures 2 and 3). This breaks the adhesion between the iris and the posterior chamber lens and directs the optic into position (Figure 4).

Steinert and Puliafito[19] have reported using the YAG laser to correct pupillary capture. The YAG laser is focused just anterior to the optic where it is captured; the pulse wave following optical breakdown moves the lens back into the posterior chamber.

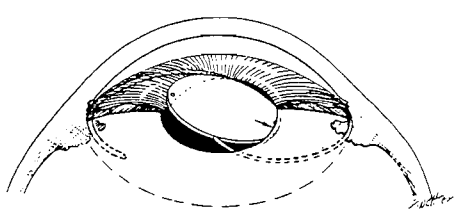

Fig. 2. (Smith) Schematic illustration showing pupillary capture of the optic (left). The first step in repair is to determine the axis of the implant loops (arrow) (from Lindstrom[7]).

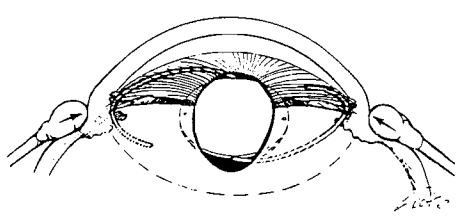

Fig. 3. (Smith) Pressure is applied to the sclera over the lens loops with two Q-tips that have been soaked in topical proparacaine (from Lindstrom[7]).

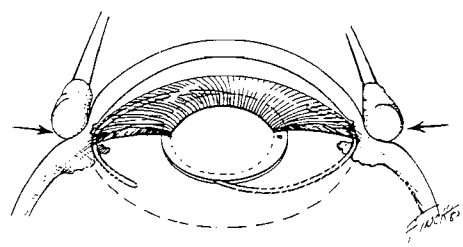

Fig. 4. (Smith) The Q-tip compression shortens the lens loops and secondarily forces the lens optic posteriorly, repairing the pupil capture (from Lindstrom[7]).

An iridectomy should be performed if there is total pupillary capture or synechial formation and a peripheral iridectomy was not performed intraoperatively. Steroids should be used to treat chronic iritis, if present, and subconjunctival steroids may also be helpful in cases of chronic CME. Eyes with pupillary capture that are unresponsive to these methods and do not have CME or chronic iritis that may be associated with progressive corneal endothelial cell loss may just be observed. Rarely will these patients need invasive surgical intervention.[18]

OPTIC DECENTRATION

Clinically significant optic decentration occurs when the optical center of the IOL has been displaced sufficiently so that the positioning holes and/or edge of the optic is within the normal pupillary space (Figure 5). This has been described by Fava,[20] Kratz,[4] and Pallin.[16] The incidence has been reported by Pallin[16] as 3.0% in 150 eyes and by Kratz[4] as 0.4% in 1,000 cases. Böke and Krüger[21] have noted visually insignificant slight decentrations to occur in 25.1% of cases. Patients with significant optic decentrations will usually complain of glare and only rarely of decreased visual acuity. The most frequent cause of this problem is a posterior chamber lens with one loop in the capsular bag and the other in the ciliary sulcus. The lens may also decenter slightly if the zonules are broken and one loop has protruded through a break in the zonules. Sheets[11] described this decentration as occurring secondary to erosion of the lens into the ciliary body. Olson[22] demonstrated instances where improperly manufactured IOLs had one loop shorter than the other. If undetected, these IOLs could produce this problem.

Using miotic agents constitutes the initial management of patients with optic decentration. The induced miosis eliminates the glare problems in the majority of patients. We have also seen cases in which eventual opacification of the posterior capsule by Elschnig pearl migration to the optic edge and/or under the optic hole created an artificial pupil, eliminating glare and halo symptoms. In some cases, eventual YAG laser capsulotomy which left the opaque capsule intact behind the decentered lens optic edge and hole resulted in total resolution of symptoms. This situation is then analogous to an optical iridectomy with a clear lens behind an opening, allowing good visual acuity even though it is not centrally located. Since the visual acuity is very good in the majority of cases, it is usually wise to delay any surgical intervention in these patients.[18] If decentration is visually significant, however, repair is indicated.[23] The surgical technique is described under the sunrise syndrome. To prevent this problem, we recommend symmetrical placement of both loops in the ciliary sulcus or the capsular bag. The use of a viscoelastic substance to fill the bag facilitates accurate placement.[24] Pallin and Walman[25] and Gills[26] feel that bag fixation prevents optic decentration.

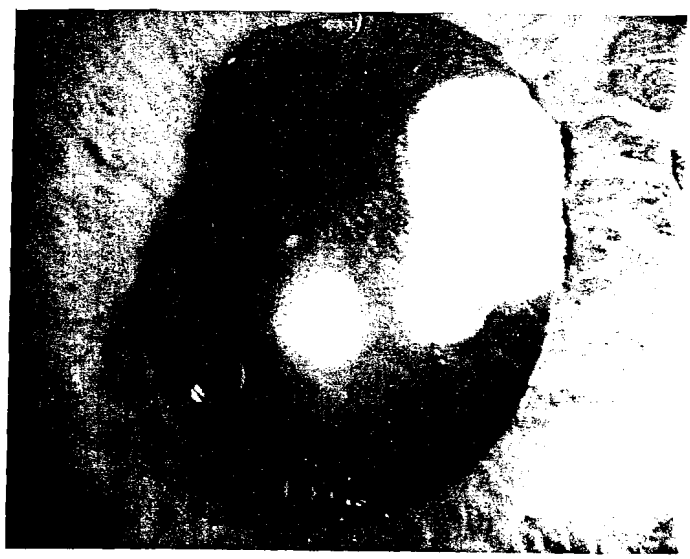

Fig. 5. (Smith) In optic decentration, the positioning hole and/or edge of the implant are within the pupillary space in an undilated pupil.

MALPOSITIONED LOOP

The term malpositioned loop encompasses all cases in which the loop is not located in the ciliary body or the capsular bag. This would include loops that dislocate through the iridectomy (Figure 6) or into the anterior chamber. Patients with a malpositioned loop may be asymptomatic or they may present with iritis and/or hyphema (Figure 7). This problem is caused by poor visualization of the loop during insertion or late rotation or migration of the IOL. The initial management is observation. Gonioscopy should be performed to determine the exact position of the loops and any reaction of the eye to the loop. Fibrosis may be associated with J-looped or C-looped supports present in the anterior chamber angle. If there is evidence of hyphema, iris

Fig. 6. (Smith) The lens loop may subluxate into the anterior chamber through a large basal peripheral iridectomy.

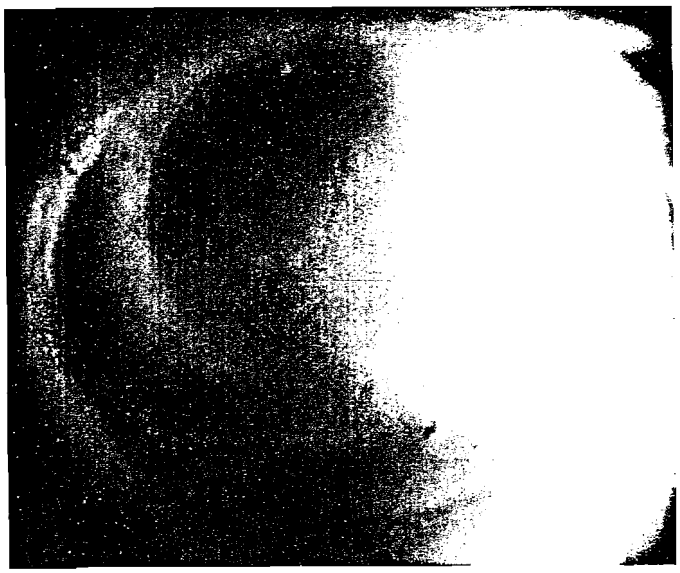

Fig. 7. (Smith) Hyphema associated with posterior chamber intraocular lens.

angiography should be performed to search for the source of the problem and to delineate the role of the malpositioned loop. In some instances loop malposition forces the optic to assume an aberrant position such that its edge rubs against uveal tissue. In the case depicted in Figure 8, angiography revealed no leakage from the area where the haptic was present on the iris, but rather leakage inferiorly from within the stroma. A systemic workup revealed that the patient had acute leukemia with probable infiltration in the iris. If there is evidence of inflammation, the eye should be treated with topical steroids.

The problem is best prevented by careful visualization of loop placement intraoperatively. Avoidance of large basal peripheral iridectomies should also reduce the incidence of this complication.

Fig. 8. (Smith) Gonial photograph of loop in the superior-peripheral iridectomy.

WINDSHIELD WIPER SYNDROME

Windshield wiper syndrome describes an IOL that appears relatively stable inferiorly and rocks from side to side superiorly (Figure 9). When the patient tips his or her head from right to left, the optic and superior loop move side to side in response to gravity. This syndrome has been described by Apple,[18] Fava and Kline,[20] Sheets,[11] and Sinskey.[27,28] The reported incidence of this problem is small. In a series of 2,500 cases, Kline (O.R. Kline, Jr., M.D., U.S. Intraocular Lens Symposium, Los Angeles, April 1984) removed five lenses (0.24%) for windshield wiper syndrome.

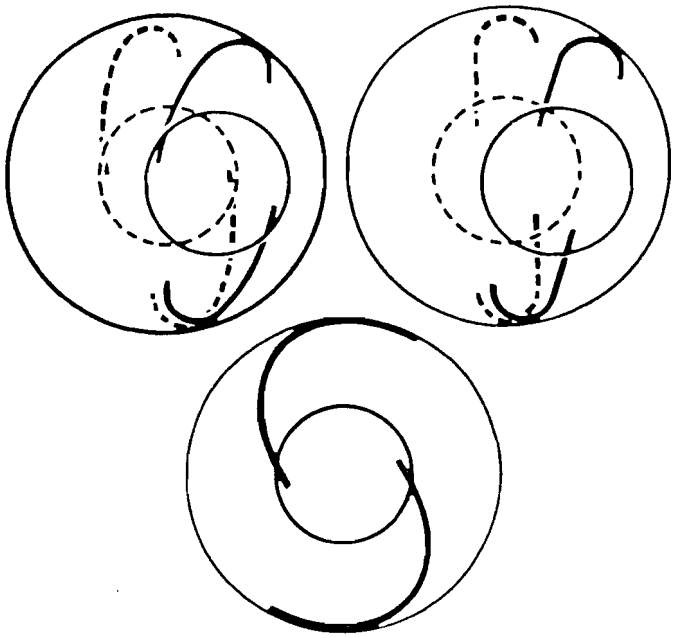

Fig. 9. (Smith) The windshield-wiper syndrome occurs when a vertical lens implant rocks from side to side on head movement.

These patients generally report glare and frequently have decreased visual acuity. They may also report having intermittent diplopia. Iritis with an accompanying CME may occur with prolonged uveal irritation. The condition occurs when the IOL is too short for the particular eye.[20,29] Another etiology is that the IOL slides through an inferior zonule disinsertion, thereby creating a disproportionate sizing between the IOL and the eye.

This problem is best managed by placing a McCannel suture as classically described[30] or by adopting a modified method.[14,31,32] The IOL can also be exchanged for a longer posterior chamber lens.[20,27] The incidence of this problem can be reduced by rotating the IOL horizontally, by using an IOL with a 14 mm or greater diameter, or by placing both loops in the capsular bag.[11,26,28]

SUNRISE SYNDROME

The sunrise syndrome occurs when the IOL optic is displaced superiorly out of the visual axis (Figure 10).[32]

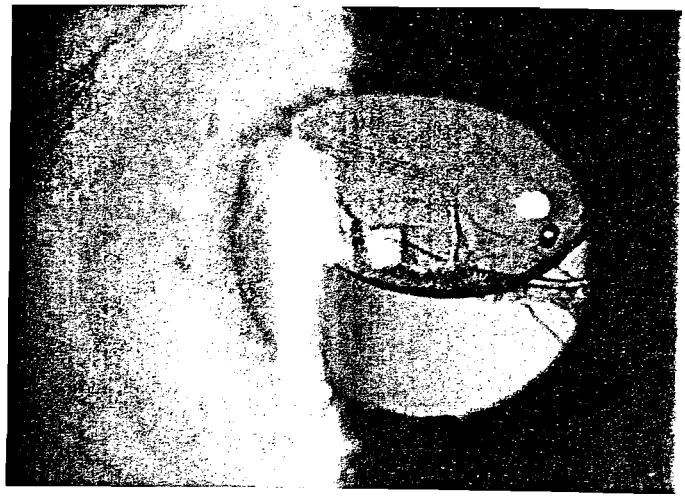

Fig. 10. (Smith) In the sunrise syndrome, the optic of the posterior chamber lens is dragged superior to the visual axis.

One cause of this problem is inferior zonular disinsertion with an in-the-bag placement of a flexible loop posterior chamber lens. The fibrosis of the capsular bag then drags the optic superiorly until the edge of the optic is in or above the visual axis. Additional causes are (1) when the inferior loop is placed within the bag and the superior loop in the sulcus and (2) when the superior loop in the sulcus and (2) when the superior zonules have been disrupted and the inferior loop is in the bag and the superior loop is through the disinsertion. The incidence of this problem is quite low, with one case being reported by Smith and Lindstrom.[32] Late decentration nasally and temporally should be included in this category if caused by the same mechanism. This has been noted by Pallin.[16]

The solution for this problem usually requires surgical repositioning. It is less serious than the sunset syndrome because the lens is less likely to subluxate completely into the vitreous. It is important to evaluate the capsular bag's zonular attachments to avoid rotating a loop through a dehiscence. The corneal endothelium should be examined by standard techniques to assess whether it can withstand another surgical procedure. Our recommended surgical revision uses two separate stab incisions that are made in the eye on either side of one loop. A viscoelastic substance is injected in the anterior chamber. The optic is then disengaged from the capsular bag using a Sinskey hook and a Bonn micro-iris hook. To enhance visualization of the loops prior to suture placement, the optic is prolapsed into the anterior chamber, creating a total pupillary capture (Figure 11).

The McCannel sutures can then be placed in a modified fashion using a sterile disposable 25-gauge needle.[31,32] The needle is introduced through a corneal stab wound over the iris, through the iris and underneath the loop, back out through the iris on the opposite side, and out through the previously made stab wound (Figure 12). A 10-0 polypropylene (Prolene®) suture is threaded through the needle and the needle is withdrawn. The suture is retrieved using a Bonn micro-iris hook and then tied and trimmed. The procedure can be repeated for the opposite loop. When both loops have been secured to the iris, the optic can be prolapsed back into the posterior chamber in a central position. Slightly larger incisions over the area of suturing may be helpful in pulling the suture out with the Bonn micro-iris hook. Sphincterotomies can be performed if necessary (Figure 13). The postoperative result is functionally and cosmetically satisfactory (Figure 14).

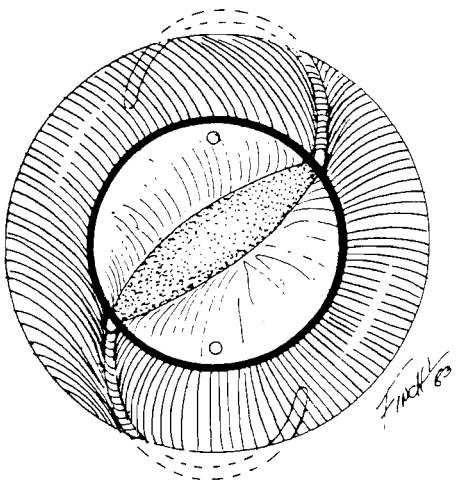

Fig. 11. (Smith) The first step in treating the sunrise syndrome is to induce a total pupillary capture by prolapsing the entire optic into the anterior chamber (from Smith[32]).

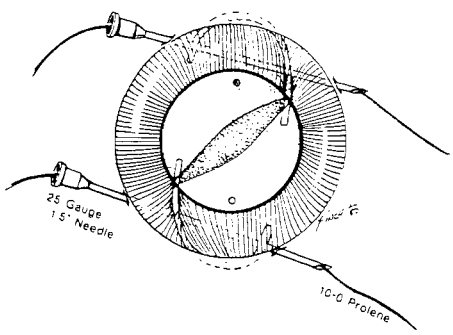

Fig. 12. (Smith) A suture is passed through the iris, behind the loop, and back through the iris after being threaded through a 25-gauge needle that was introduced through the limbus (from Smith[32]).

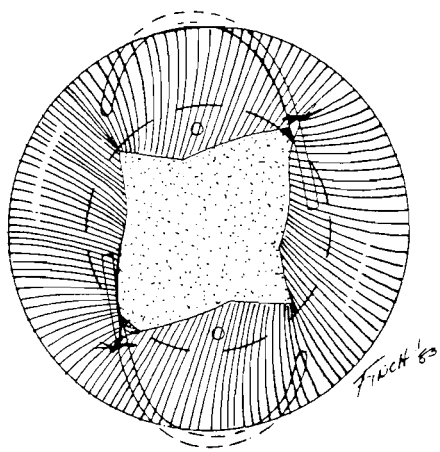

Fig. 13. (Smith) The trimmed sutures are tied, the IOL optic repositioned in the posterior chamber, and sphincterotomies performed if needed to center the pupil (from Smith[32]).

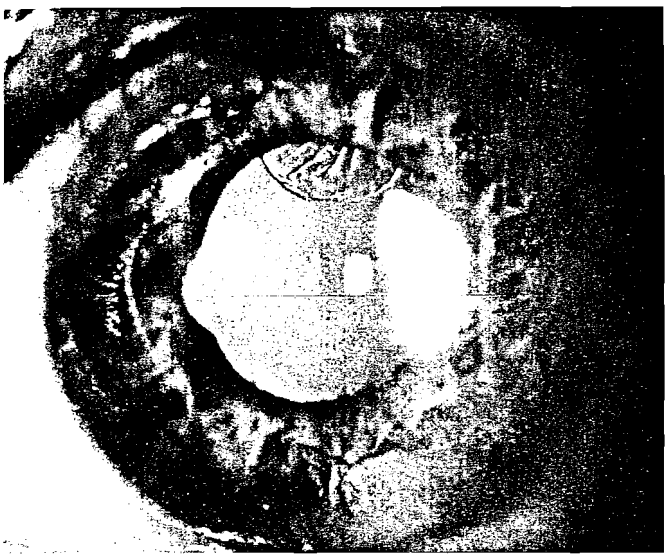

Fig. 14. (Smith) Postoperative photograph of an eye following sunrise syndrome repair with repositioning of the IOL, sphincterotomies, and polypropylene sutures to the iris.

The sunrise syndrome can be prevented by placing the optic outside the capsular bag with consideration of a McCannel suture if zonular disinsertion is noted at the time of surgery. We favor a four-point fixation posterior chamber lens placed in the ciliary sulcus since more stability is afforded by the four-point fixation. This problem can also be avoided by using an anterior chamber lens if there is zonular disinsertion; this is the procedure of choice if there is significant disinsertion.

SUNSET SYNDROME

The sunset syndrome occurs when the optic of an IOL is displaced below the visual axis (Figure 15).[4,14,15,18,29] These patients complain of glare and decreased visual acuity. The incidence of this problem has been variously reported (Table 2).

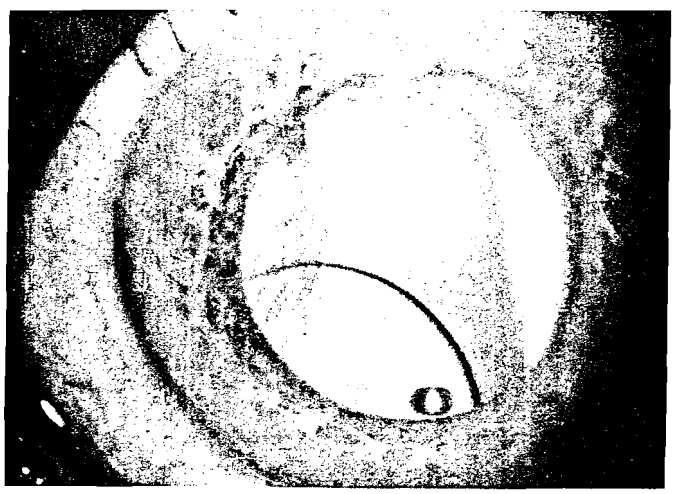

Fig. 15. (Smith) In the sunset syndrome, the optic of the posterior chamber lens subluxates below the visual axis.

Table 2. Reported incidence of sunset syndrome.

Author	Incidence	Number of Cases
Thrasher*	1.40%	1,333
Kline†	0.04%	2,500
Kratz[33]	0.40%	1,000
Pallin[16]	2.00%	150
Stark[34]	1.80%	311
Southwick and Olson[15]	0.60%	256

*_Ophthalmology Times_, June 1, 1981, p 51
†U.S. Intraocular Lens Symposium, Los Angeles, April 1984

This condition is caused by inferior zonular disinsertion in the presence of a vertically placed sulcus fixated IOL.[4,18,21] This problem may occur more frequently with a stiff loop IOL, such as the early Shearing style lens, than with the softer loop Sinskey/Kratz style because greater pressure is transmitted to the inferior zonules on inserting the superior loop of the less flexible lens. It may occur through a primary capsulotomy.[25] Apple[18] has reported two cases caused by a broken loop allowing the IOL to decenter. This problem can also be caused by trauma.[35] Depending on the severity of the injury, the lens may be subluxated subconjunctivally or extraocularly.[36,37]

This problem is surgically correctable by one of three methods. The first is to induce a total pupillary capture and leave the IOL in this position.[14,29] The second is to reposition the lens with or without a McCannel suture as described for the sunrise syndrome. The third method is to remove the lens entirely and replace it with an anterior chamber IOL.[27]

The incidence of this problem can be reduced by routine horizontal placement of the IOL.[24,33] Sheets[11] has noted sunset syndromes with sulcus-fixated IOLs but not with bag-fixated IOLs. He strongly recommends capsular bag fixation and feels IOL rotation may unzip some zonules. Pallin,[16] Graether,[24] and Gills[26] also support bag placement to reduce this problem. We routinely rotate the lens to a horizontal position and we have noted no complications related to this maneuver to date. If zonular disinsertion is noted intraoperatively, consideration should be given to the placement of a four-point fixated posterior chamber lens in the ciliary sulcus to allow maximum stability in the posterior chamber. McCannel suturing can also be performed or the surgeon may elect to insert an anterior chamber lens.

LOST LENS SYNDROME

In a lost lens syndrome, the posterior chamber lens is completely dislocated into the vitreous cavity (Figure 16). Numerous reports of iris fixated lenses subluxated into the vitreous have been described, but few posterior chamber lenses subluxated into the vitreous

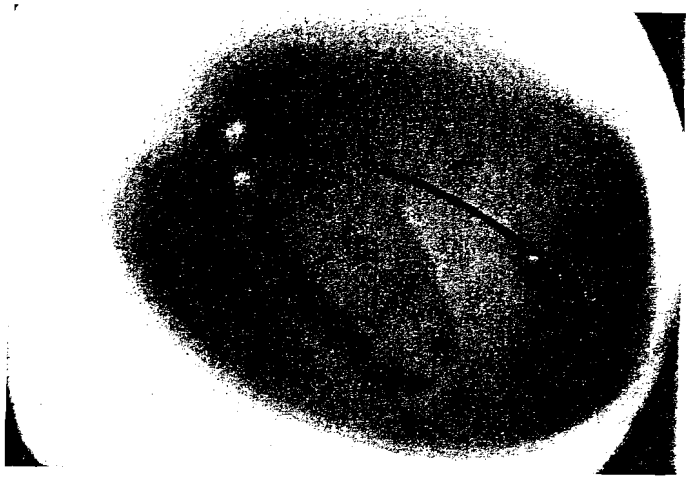

Fig. 16. (Smith) In the lost lens syndrome, the IOL completely subluxates into the vitreous cavity (photograph courtesy of Walter Stark, M.D.).

Fig. 17. (Smith) The loop of the posterior chamber lens has subluxated into the anterior chamber with intermittent touch of the corneal endothelium.

have been reported. In a series of 1,333 cases by Thrasher (*Ophthalmology Times*, June 1, 1981, p 51), 2,500 cases by Kline (O.R. Kline, Jr., M.D., U.S. Intraocular Lens Symposium, Los Angeles, April 1984) and 1,000 cases by Kratz,[33] this problem was not noted to occur. It has been reported to occur with posterior chamber lenses by Sinskey[27] and Stark.[34]

This problem is caused by luxation of the implant through an inferior zonular disinsertion, as in a complete sunset syndrome, or through an unrecognized opening in the posterior capsule intraoperatively with placement of the lens behind the posterior capsule through the discission. It can also occur with trauma.

Management of patients with posterior chamber lenses subluxated into the vitreous is controversial. Initially, observation is the best course of action. If the eye is quiet and without evidence of CME or of retinal damage, the IOL can be left in the vitreous and the eye can either be fit with an extended wear soft contact lens or by insertion of an anterior chamber IOL with good visual results.[15,27,38,39] A complete retinal evaluation with scleral depression is necessary to make sure there is no damage to the retina from the IOL. Mobility of the IOL in the vitreous should also be assessed. Stark et al.[40] have stated that an IOL in a partially liquefied vitreous should be removed. If there is chronic CME, the surgeon must be suspicious of the IOL movement as the etiology since the PMMA material when immobilized is well tolerated.[41] In one of our patients, the IOL appeared well situated with no movement on each exam. On indirect ophthalmoscopy no optic was visible; on gonioscopy the haptic was seen just over the ora serrata. During the next nine months the patient developed chronic CME. We felt this was related to the IOL but did not understand the exact mechanism until the patient presented with increased irritation and, as seen in Figure 17, we found that the loop extended over the iris and was in intermittent contact with the corneal endothelium. Presumably, the lens was hinged by the loop nearest the iris and was freely moveable according to the patient's position. The intermittent endothelial touch then caused iritis, CME, and intermittent corneal edema requiring IOL removal.

If surgical removal or repositioning is undertaken, there should be two surgeons present; one skilled in posterior vitrectomy and the other in anterior segment surgery. The technique is generally that described by Stark, Michels, and Bruner.[40] After complete vitrectomy is performed, the lens can be maneuvered and brought up to the pupillary space. At this point, pupillary capture should be induced by the vitrectomy surgeon. In our experience, this has been the easiest way to maneuver the lens for repositioning. It is more difficult for the anterior segment surgeon to take the implant from the vitrectomy surgeon through forceps that have entered the eye from the limbal incision. If the lens is to be removed because there is no capsular bag, presenting the IOL to the second surgeon through a large corneal wound is recommended. The eye should be evaluated preoperatively and then intraoperatively for the presence of adequate posterior capsule and zonules to insure stability of the loops in deciding whether to reposition or remove the lens. If capsular support is present, the loops can be placed in the ciliary sulcus under direct visualization. This is usually easy to accomplish with the first loop; however, the second loop may be more difficult in the closed system. The combination of a Graether collar button to retract the iris and use as a fulcrum for bending the loop and a Kelman-McPherson forceps to maneuver the loop in the other hand has worked well for us. Following placement of both loops in the ciliary sulcus, pupillary capture can be induced and the iris sutures may be placed as for the sunrise syndrome. The posterior segment surgeon should then complete any further vitrectomy and may elect to perform cryopexy and/or

placement of a retinal band following examination of the retina and completion of the vitrectomy procedure.

To prevent the lost lens syndrome, it is important to recognize any zonular disinsertion and the competence of the posterior capsule intraoperatively. If there is large area of disinsertion or posterior capsule tear, we prefer a four-point fixated posterior chamber lens placed in the ciliary sulcus or an anterior chamber lens.

CONCLUSION

In summary, the malposition of a posterior chamber lens can occur, but is relatively infrequent and is usually mild in nature. This article has reviewed the different forms, etiologies, prevention, and management of these posterior chamber IOL complications. Improved lens designs such as posterior angulation, increased surgeon experience, and placement of supporting loops in the capsular bag are all helping to reduce the incidence of positioning problems. As surgeons become more experienced with extracapsular cataract extraction and posterior chamber lens implantation, the ability to recognize and manage intraoperatively the situations that lead to lens malposition will help reduce the incidence of this complication.

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